No of Pages : 3 Course Code: 08P401

Roll No:
(To be filled in by the candidate)

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

SEMESTER EXAMINATIONS, FEBRUARY / MARCH - 2014

BE / (SW) BE - PRODUCTION ENGINEERING Semester: 4

08P401 FLUID MECHANICS AND MACHINERY

Time: 3 Hours **Maximum Marks: 100**

INSTRUCTIONS:

1. Group I and Group II questions should be answered in the Main Answer Book.
2. Answer any **FIVE** questions in Group II.
3. Answer **ALL** questions in Group I and Group III.
4. Group III – **Multiple Choice questions** - (which will be given to the candidates half an hour before the scheduled close of the examination) **should be answered only** in the space provided **in the Main Answer Book.**

GROUP I **Marks: 10 x 3 = 30**

1. Define Newton's law of viscosity.
2. What is surface tension?
3. State the 3D continuity equation.
4. Write the significance of stream function.
5. Differentiate between total energy line and hydraulic gradient line.
6. Give an example where the minor losses in pipes are more significant.
7. Define vapor pressure.
8. What is displacement thickness?
9. Define net positive suction head.
10. Draw the inlet and outlet velocity diagram of Kaplan turbine.

GROUP II **Marks: 5 x 12 = 60**

11. The water in a tank is pressurized by air and a multi-fluid manometer as shown in figure below measures the pressure. Determine the gage pressure of air in the tank with the following information. $h_1 = 0.2$ m; $h_2 = 0.3$ m; $h_3 = 0.46$ m; $\rho_{water} = 1000$ kg/m^3; $\rho_{oil} = 850$ kg/m^3; $\rho_{mercury} = 13600$ kg/m^3.

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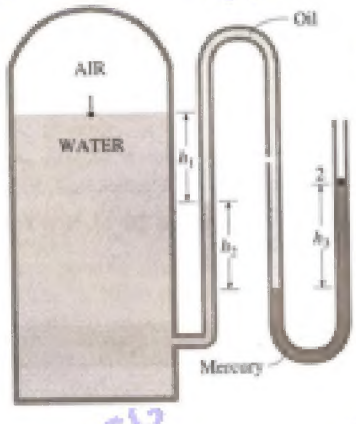
12. Find the convective acceleration at the middle of a pipe which converges uniformly from 0.4 m to 0.2 m diameter over 2 m length. The rate of flow is 20 lit /s. If the rate of flow changes uniformly from 20 lit /s to 40 lit /s in 30 seconds. Find the total acceleration at the middle of the pipe at 15th second.
13. Water enters a hydraulic turbine through a 30 cm diameter pipe at a rate of 0.6 m^3/s and exits through a 25 cm diameter pipe. The pressure drop in the turbine is measured by a mercury manometer to be 1.2 m. For a combined turbine-generator efficiency of 83%, determine the net electric power output. Disregard the effect of kinetic energy correction factors. Neglect the elevation difference across the turbine.
14. A model test of a tractor-trailer test rig is performed in a wind tunnel. The drag force is found to depend on frontal area A, wind speed V, air density ρ, and air viscosity μ. The model scale is 1:4. Frontal area is 0.625m^2. Obtain a set of dimensionless parameters suitable to characterize the model test results. State the conditions to obtain dynamic similarity between model and prototype flows. When tested at wind speed 89.6m/s, in standard air, the measured drag force on the model was 2.46kN. Estimate the aerodynamic drag force on the full-scale vehicle at 22.4m/s. Calculate the power required to overcome this drag force.
15. The inlet and the outlet diameters of an inward flow reaction turbine with radial flow at the outlet are 1.20 m, 0.60 m respectively. Water enters the wheel at a velocity of 30 m/s at an angle of 30° to the wheel tangent and leaves the vanes with a velocity of flow of 4.20 m/s. The inlet and outlet vane angles of the moving vanes are 40° and 35° respectively. Find the power supplied to the runner and the speed of the turbine.
16. A 400mm diameter cast iron pipe 400m long connects two reservoirs. The ends of the pipe are square cornered and submerged. When the rate of flow through the pipe is 0.35 m^3/s, find the difference in levels of the water surfaces in the two reservoirs. Take f = 0.005.



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Write the Alphabet of your choice answer for each question in the space provided in the Main Answer Book
(Do not attach this question paper along with the Main Answer Book)

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GROUP III **Marks: 10 x 1 = 10**

I) For a given centrifugal pump
A) The discharge varies directly as the speed
B) head varies inversely as the speed
C) power varies as the square of the speed
D) discharge varies as the square of the speed

II) The bulk modulus of elasticity
A) is independent of pressure and viscosity
B) increase with pressure
C) has the dimensions of inverse of Pressure
D) is larger when the fluid is more compressible

III) A 7cm diameter pipe supplies water to a 4cm diameter jet at a rate of 0.101 m^3/s. when the pressure is 101kPa, what is the average velocity in the water supply line?
A) 0.81m/s **B)** 1.62m/s **C)** 2.62m/s **D)** 23m/s

IV) The operating point of a pump installed in a pipeline is decided by
A) Speed of the pump **B)** opening of the delivery valve
C) length of the pipeline **D)** system characteristics

V) The fluid forces considered in the Navier-Stokes equation are
A) gravity, pressure and viscous **B)** gravity, pressure and turbulent
C) pressure, viscous and turbulent **D)** gravity, viscous and turbulent

VI) To replace a compound pipe by a new pipe, the pipes will be equivalent when both the pipes have same
A) length and flow rate **B)** diameter and flow rate
C) head loss and flow rate **D)** length and head loss

VII) On a standard day a pressure gauge placed below the surface of the ocean (SG = 1.025) reads an absolute pressure of 1.4 MPa. How deep is this instrument?
A) 4m **B)** 129m **C)** 133m **D)** 140m

VIII) Two parallel plates, one moving at 4m/s and the other stationary are separated by a 5mm thick oil layer with S = 0.8 and viscosity 1.25 E-4 m^2/s. what is the average shear stress in the oil layer?
A) 80 Pa **B)** 100Pa **C)** 125Pa **D)** 160Pa

IX) The flow in a river during the period of heavy rainfall is
A) unsteady, non-uniform, 2-dimensional **B)** steady, uniform, 2-dimensional.
C) Unsteady, uniform, 3-dimensional **D)** unsteady, non-uniform, 3-dimensional

X) In series pipe application
A) energy gradient remains same through all the pipes
B) hydraulic gradient remains same through all the pipes
C) head loss is same through all the pipes
D) total head loss is the sum of individual head loss through each pipe